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ABSTRACT

Text has traditionally been the mode used to convey information in educational settings, including workplace training. Unfortunately, printed materials have little to offer persons with reading difficulties. Text may be made easier to understand by using predictable structure, shorter sentences, and less demanding vocabulary; however, such procedures do little to address the root shortcomings of instructional text in general and training manuals in particular. Hypertext and hypermedia are both effective in helping students/trainees compensate for their reading deficiencies. In hypertext, words and concepts in a text passage serve as keywords to which other information can be linked. Hypermedia involves the use of links to digital speech, music, still images, and video. This guide, which is designed to assist workplace education practitioners in developing effective instructional materials, describes the shortcomings of traditional text-based training materials, discusses the concepts of hypertext and hypermedia from the standpoint of their role in developing "responsive text," presents examples of responsive text, outlines the steps in developing responsive text, and offers suggestions regarding selecting the computer hardware and software required to begin developing responsive text materials. (Contains 13 references.) MN)

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ED 363 749

The Commonwealth of Massachusetts

Department of Education

TRANSFORMING THE TRAINING MANUAL INTO A LEARNING EXPERIENCE

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SEPTEMBER, 1993

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Developed and Written by:
Michael Hillinger

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Robert V. Antonucci
Commissioner

September, 1993

I am pleased to present this publication developed through our Massachusetts Workplace Education Initiative. This publication is part of a series of resources developed for and by workplace education practitioners in business, education, and labor partnerships funded through our Department's Workplace Literacy Program.

These resources are the result of our commitment to strengthening the capacity, knowledge base, and quality of the field and to provide much-needed and long-awaited information on highly-innovative and replicable practices. These resources also complement the curriculum framework of staff training and development initiatives that were successfully developed and piloted in conjunction with the field during the past fiscal year and represent an oustanding example of the Department's theme: " Working Together for Better Results."

Each of these publications was written by trainers and workshop presenters who have participated in the training of new workplace education staff. All publications provide invaluable information on important aspects of workplace education programming. All documents begin with an overview of the field or current-state-of-the-art section as it relates to the topic at hand. Then, they move into the practitioner's experience. Next, the training plan of presenters is discussed. Each publication ends with a list of resources.

We are confident that with this series of publications we have begun an exciting but challenging journey that will further support workplaces in their progression towards becoming high-performance work organizations.

Sincerely,

Robert V. Antonucci
Commisioner of Education

ACKNOWLEDGEMENTS

Individuals, groups, and organizations that helped in the development of this document:

Michael Hillinger, Bob Bozarjian, Johan Uvin

WORKPLACE EDUCATION RESOURCE SERIES:

Workplace Education Mentoring Pilot Project Final Report
17419-82-150-9/93-DOE

Workplace Education Sample Evaluation Report
17420-30-150-9/93-DOE

Workplace Education Mini-Course Pilot Project Final Report
17421-44-150-9/93-DOE

Transforming the Training Manual into a Learning Experience
17422-19-150-9/93-DOE

Math in the Workplace
17423-20-150-9/93-DOE

Learning Differently in Adult Education: Development of a Learning Disabilities Component At Hampden Papers, Inc.
17424-43-150-9/93-DOE

The Role of Counseling in Workplace Education:
Educational and Career Counseling at New England Medical Center
17425-66-150-9/93-DOE

September 15, 1993

Transforming the Training Manual into a Learning Experience

Michael Hillinger
LexIcon Systems
Sharon, VT

Overview

This paper summarizes the points made at a Workplace Education Minicourse on Materials Development. It begins with a description of the challenges to and shortcomings of traditional text-based training material. It then describes the concepts of hypertext and hypermedia, especially in reference to designing basic skills materials called Responsive Text. Some Responsive Text examples are then described. Finally we describe the hardware and software required to begin developing materials as well as the level of technical competence.

The Problem

Text as been the mode of choice for conveying information since the invention of movable type. Unfortunately the printed page has little to offer those with reading difficulties. We can make the text more "considerate" (Armbruster & Anderson, 1981) by using predictable structure, shorter sentences, and less demanding vocabulary, but this procedure does little to address the root deficiency.

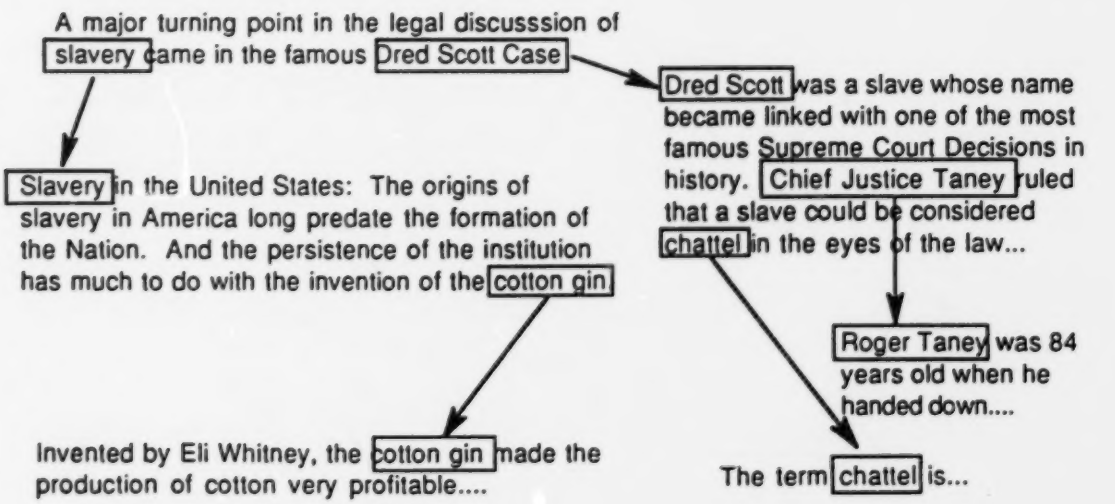
This shortcomings of plain text is even more apparent in workplace training. While the training manual is not the only kind of training modality used--video, classroom instruction, on the job training, etc., are also available-- it is the most pervasive. A typical training manual contains dense text covering complex procedures and this makes it even more difficult to comprehend than more mainstream reading. Usually, there are charts, graphs, and calculations that demand competency beyond those considered as "literacy".

We are exploring new ways of thinking about text, based on the use of hypertext and hypermedia, that address some of the problems with text as a training medium.

Hypertext and Hypermedia

With the advent of ever more powerful computers and larger databases there have been many efforts to re-evaluate how information can be stored and accessed. Over the last decade there has been an effort to replace the rigid data organization of early computers with non-linear access methods more akin to the way humans use information. This organization scheme called hypertext (Conklin, 1987) uses the words and concepts in a text passage as keywords to which other information can be linked.

For example, A text passage on the causes of the Civil War may introduce many new words and concepts such as Dred Scott, chattel, and cotton gin. In hypertext (see figures below), the reader interested in leaning more about an item, say Dred Scott, could select it (perhaps by touching it with a cursor) and the computer would display a selection about the famous Supreme Court case. While reading this passage the reader may be intrigued by the character of Chief Justice Taney. As before, selecting his name would lead to a passage on him. This browsing between keywords and associated text could, in principle, go on indefinitely. Links could also be made to digital speech, music, still images, and video. The reader could see a picture of Dred Scott, hear a reading of Justice Taney's ruling and even experience a video clip from *Roots* to experience the personal side of slavery. This powerful information tool is known as hypermedia.


A major turning point in the legal discusssion of slavery came in the famous Dred Scott Case
Dred Scott was a slave whose name became linked with one of the most famous Supreme Court Decisions in history. Chief Justice Taney ruled that a slave could be considered chattel in the eyes of the law...
Slavery in the United States: The origins of slavery in America long predate the formation of the Nation. And the persistence of the institution has much to do with the invention of the cotton gin.
Roger Taney was 84 years old when he handed down....
Invented by Eli Whitney, the cotton gin made the production of cotton very profitable....
The term chattel is...

Hypertext Information Links

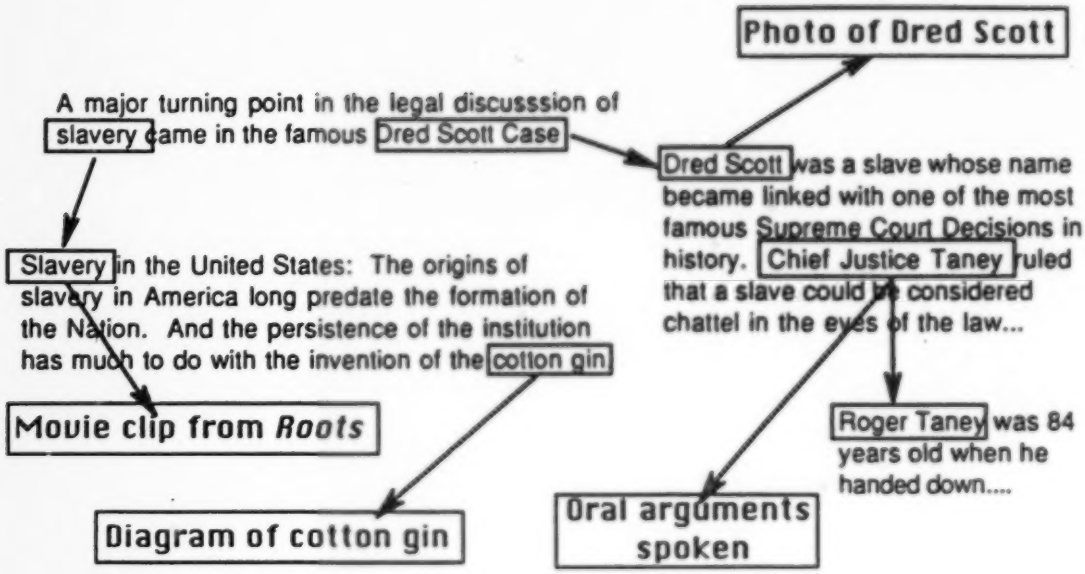


Photo of Dred Scott
A major turning point in the legal discusssion of slavery came in the famous Dred Scott Case
Dred Scott was a slave whose name became linked with one of the most famous Supreme Court Decisions in history. Chief Justice Taney ruled that a slave could be considered chattel in the eyes of the law...
Slavery in the United States: The origins of slavery in America long predate the formation of the Nation. And the persistence of the institution has much to do with the invention of the cotton gin
Movie clip from Roots
Roger Taney was 84 years old when he handed down....
Diagram of cotton gin
Oral arguments spoken

Hypertext/Hypermedia Information Links

Responsive Text

As described, hypertext/hypermedia is an extensive medium, the surface text provides a starting point and links lead the reader away to many diverse topics. But the system works equally well as an intensive medium with links providing supplemental information to help the user read and understand the original text. For example, having the computer speak an unfamiliar word can assist in understanding that word What other kinds of support could be brought to bear?

Such supports should be based on what we know about reading deficiencies. Clearly, good readers bring many skills to the reading task. For those with less proficiency, hypermedia supports could compensate for their shortcomings. Four candidate areas of reader difficulty are:

Decoding. At the most basic level, reading proficiency requires decoding visual representations of words into a phonological representation (Gough & Hillinger, 1980). While poor readers may be able to decode words, the process is difficult and diverts attention from higher level comprehension processes.

Background knowledge. As Chall (1983) notes, reading beyond the earliest stages requires a store of background knowledge. Knowledge of vocabulary, phrases, and idioms, all gained through reading, is necessary for later reading stages. Poor

readers are often deficient in the necessary background knowledge to understand a passage.

Inferential capacity. Reading requires filling in information not explicitly stated (Collins, Brown, & Larkin, 1980). Poor readers may have difficulty explicating relationships, noting causal sequences, etc.

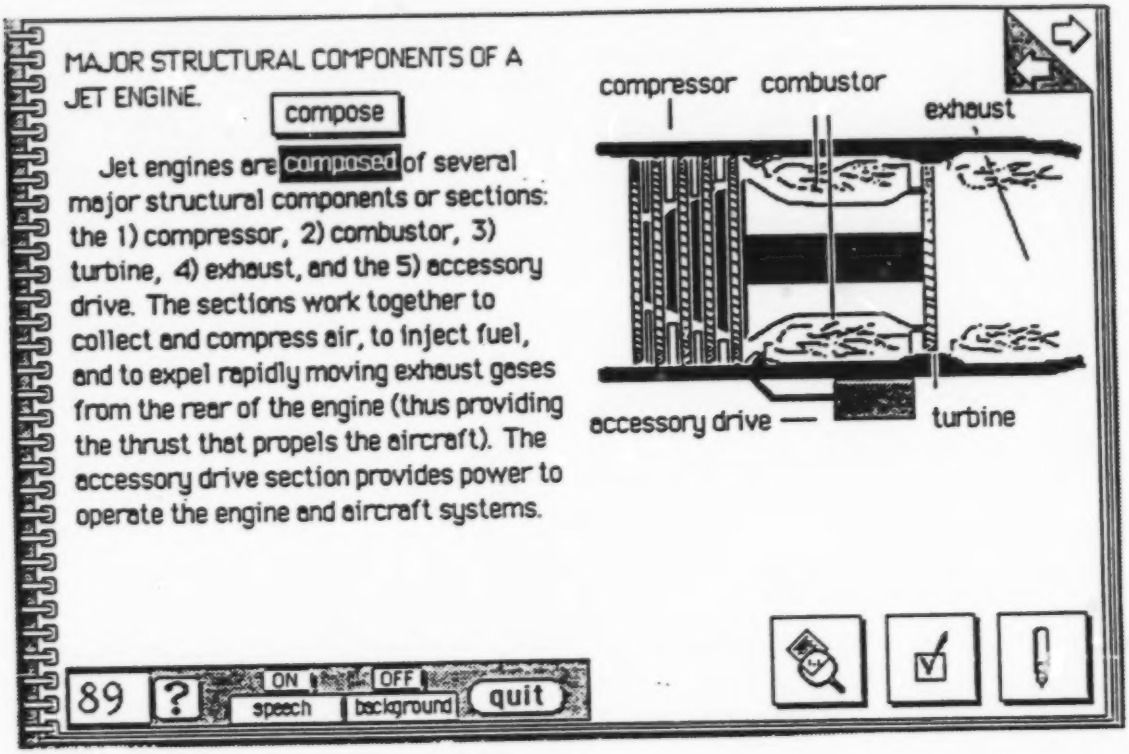
Metalinguistic Skills. As readers, we must check what we think we are reading against the information in the text. Baker & Brown (1984) have noted that poor readers often have difficulty monitoring their comprehension of a passage.

A hypermedia support system, designed to compensate for these deficiencies, can shift some of the comprehension burden from the reader to the text. The text now becomes responsive to the needs of the user. Our label for this approach is Responsive Text™ (Hillinger 1992. Similar systems have been called Computer Assisted Reading (McConkie & Zola, 1987), Computer-Mediated Text (Reinking & Schreiner,1985), and Hypertext CAI (Higgins & Boone, 1989).

A First Pass at Responsive Text

We were given the opportunity to try out these ideas as part of a Workplace Literacy Demonstration Project funded by the Federal Department of Education. The project was done at two sites: a General Electric Aircraft Engines plant in Rutland Vermont and the Burlington (VT) Electric Department. At both sites we took manuals and other materials directly relevant to the worksite and put them into a Responsive Text format. This implementation of Responsive Text was programmed for a Macintosh computer. The reader moves a mouse-controlled cursor and "selects" a word, "presses" a button, or moves an object. Consistent with the reading deficiencies identified above, four kinds of support were developed: Speech, Background Knowledge, CloseUp views, and Checkup questions.

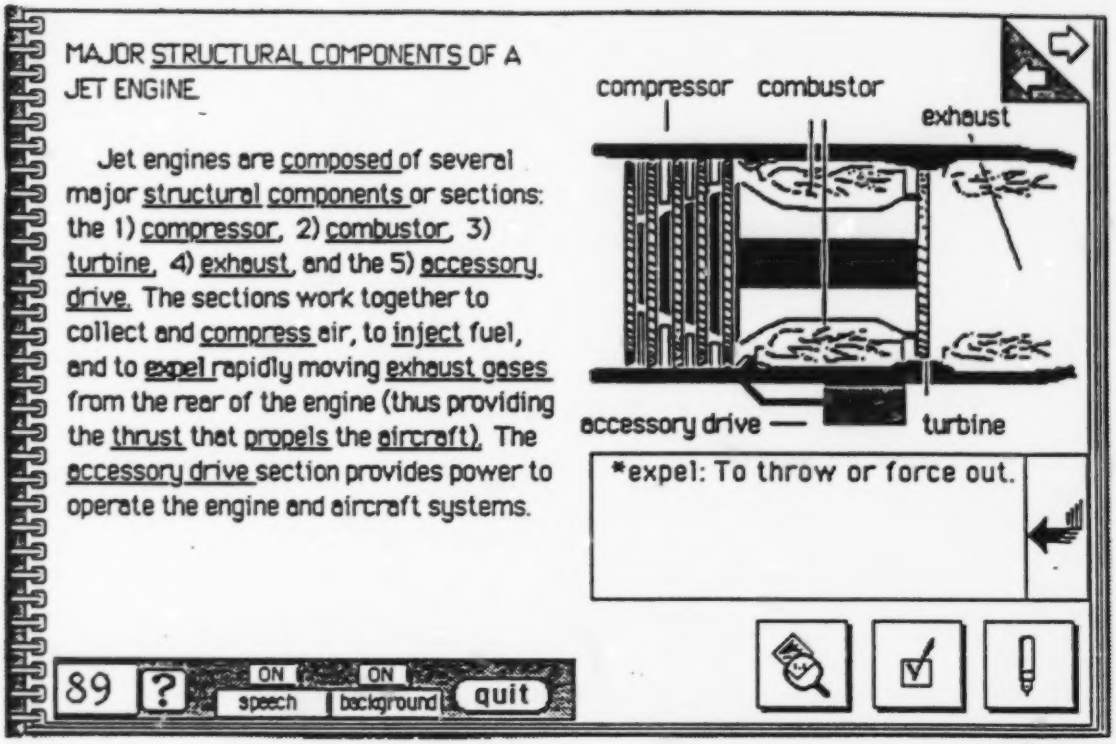
Speech Support. Speech is the most straightforward means of aiding decoding and a number of programs have used spoken representations of words to assist the reader. Responsive Text uses digitally-encoded spoken representations of words in the text. Turning on the speech mode, by clicking on the button at the page bottom, allows the reader to select words displayed anywhere on the screen and hear them spoken. Only single words are spoken and, to conserve memory space, not all words have spoken versions. (Approximately 80 percent of the words, by type, are spoken and most of the non-spoken words are familiar, high-frequency words.) With most affixed words only the base word is encoded. Thus, when clicking on the past tense composed, the present tense compose is spoken. In these cases, the singular version is displayed in a small window adjacent to the selected word


MAJOR STRUCTURAL COMPONENTS OF A JET ENGINE.
compose
Jet engines are composed of several major structural components or sections: the 1) compressor, 2) combustor, 3) turbine, 4) exhaust, and the 5) accessory drive. The sections work together to collect and compress air, to inject fuel, and to expel rapidly moving exhaust gases from the rear of the engine (thus providing the thrust that propels the aircraft). The accessory drive section provides power to operate the engine and aircraft systems.
compressor
combustor
exhaust
accessory drive
turbine
89
?
ON
OFF
speech
background
quit

The supportive nature of speech is clear in these systems. Having a spoken version of a printed word readily available allows the reader to focus on higher -level comprehension processing. Beyond immediate support, Reitsma (1988) has found this method of providing readers with independent access to spoken and visual representations of words is an effective way to teach decoding.

Background knowledge. While speech support may be sufficient for words within the reader's spoken vocabulary, unfamiliar words will require some background information. Systems developed by Reinking and Schreiner (1985), Leu (1988), and Higgins and Boone (1989), have all incorporated this level of support in the form of definitions or explanations.

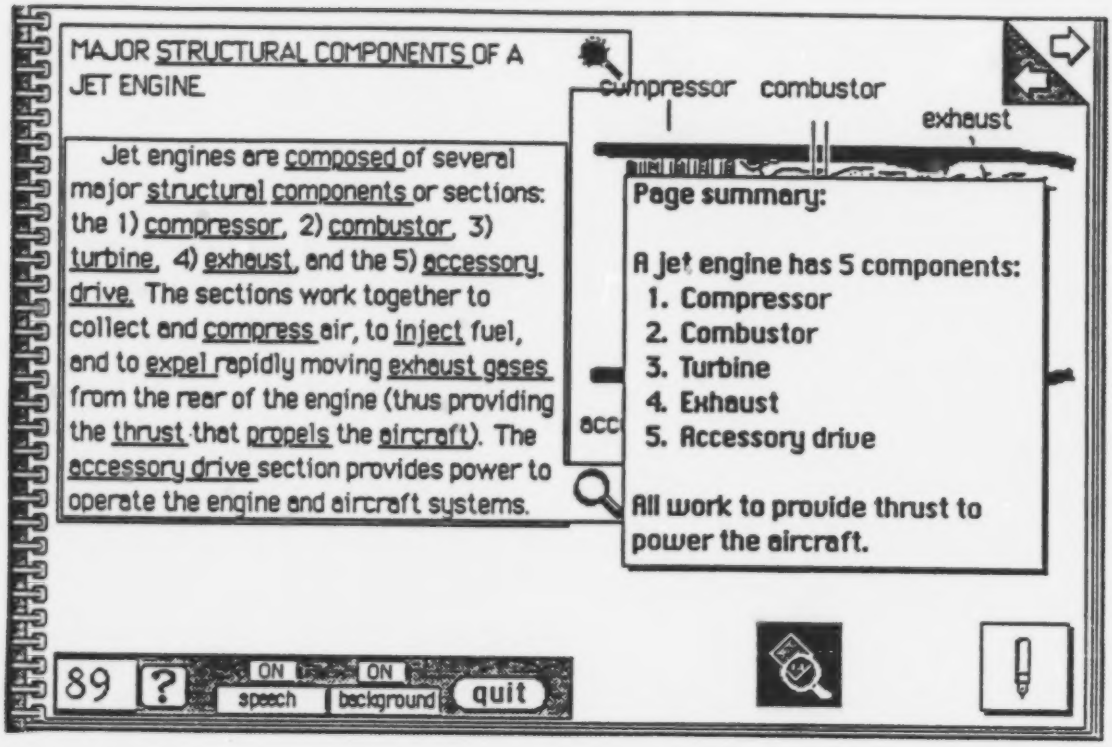
In Responsive Text this support is enabled by turning on background knowledge (a button adjacent to the speech support button). With background on, words having definitions are underlined. Selecting an underlined word causes all of its tokens to be highlighted and a brief definition is displayed.


MAJOR STRUCTURAL COMPONENTS OF A JET ENGINE
Jet engines are composed of several major structural components or sections: the 1) compressor, 2) combustor, 3) turbine, 4) exhaust, and the 5) accessory drive. The sections work together to collect and compress air, to inject fuel, and to expel rapidly moving exhaust gases from the rear of the engine (thus providing the thrust that propels the aircraft). The accessory drive section provides power to operate the engine and aircraft systems.
compressor
combustor
exhaust
accessory drive
turbine
*expel: To throw or force out.
89
?
ON
speech
ON
background
quit

While a short definition is sufficient for many of the words, some of the more technical vocabulary requires a more extensive definition. When such a word is selected, more extensive background information about the word or concept can be made available. With the links provided in hypermedia, there is no practical limit to how detailed this background information can be. For example, the word compressor links to a schematic describing compressor operations, digital images of a jet engine compressor and an extensive engine anatomy section illustrating how the compressor works with other jet engine components.

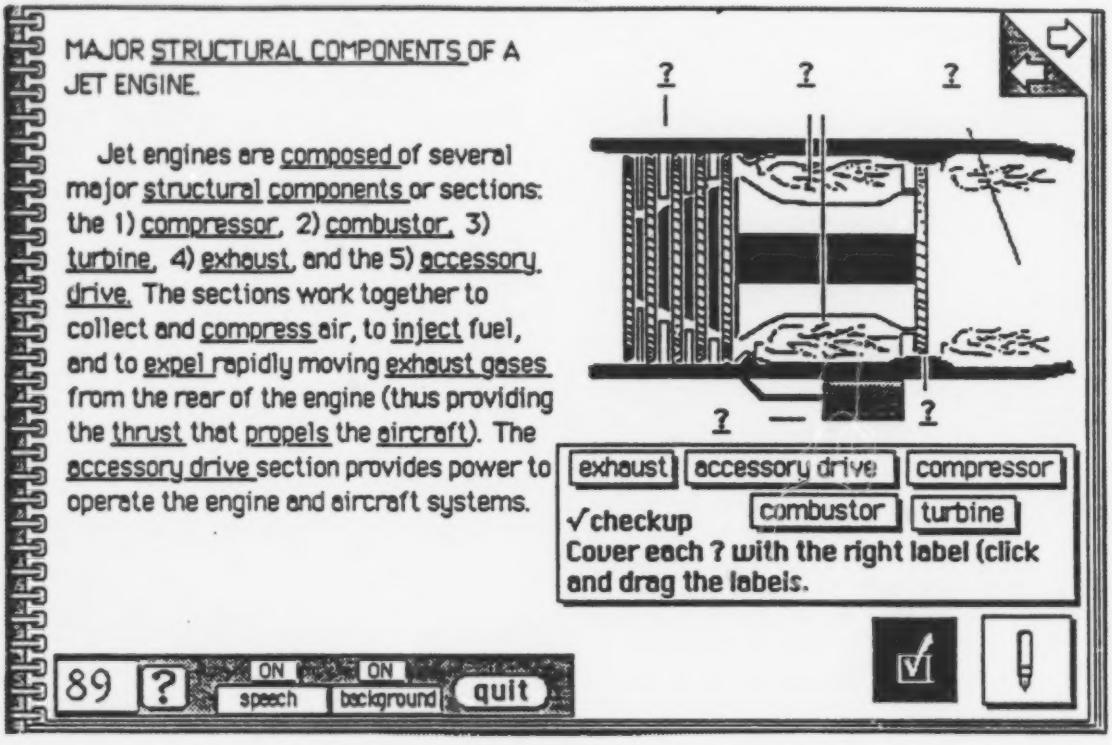
CloseUps. Both speech support and background knowledge facilitate the understanding of individual words. However, even with this support, comprehension difficulty can still occur at the passage level. The inability to see implicit information, confusion over the relative importance of ideas, or just the introduction of too many new words and concepts can make a passage incomprehensible. In Responsive Text, passage-level assistance is available through the CloseUp option. Selecting the CloseUp option (the magnifying glass icon) reveals the portions of the text that have CloseUp information available.

Providing the kind of passage-level assistance available in CloseUps is more complex than linking definitions and speech to individual words. One method is to provide a gloss for the displayed information (cf. Blohm, 1982), and every Responsive Text page has a page summary CloseUp available


MAJOR STRUCTURAL COMPONENTS OF A JET ENGINE
Jet engines are composed of several major structural components or sections: the 1) compressor, 2) combustor, 3) turbine, 4) exhaust, and the 5) accessory drive. The sections work together to collect and compress air, to inject fuel, and to expel rapidly moving exhaust gases from the rear of the engine (thus providing the thrust that propels the aircraft). The accessory drive section provides power to operate the engine and aircraft systems.
compressor
combustor
exhaust
Page summary:
A jet engine has 5 components:
1. Compressor
2. Combustor
3. Turbine
4. Exhaust
5. Accessory drive
All work to provide thrust to power the aircraft.
89
?
ON
speech
ON
background
quit

More powerful, still, is to take advantage of the computer display to dynamically restructure the text. Adding, deleting, resequencing, and highlighting text can effectively point out causal relationships, sequence information, and implicit connections. For example, Leu (1988) demonstrated pronominal reference in a computer-displayed chidren's story by dynamically replacing a pronoun with its referent, making explicit the connection between the two. Reinking and Schreiner (1985) suggest replacing a technical passage with one written at a less technical level.

Checkups. Checkup questions, available at the reader's option, allow the reader to check their passage understanding. Checkup questions can take a variety of forms. In Figure below the reader must move labels to their correct location. Using the computer's power allows checkup questions to become quite sophisticated--moving switches, testing temperatures, measuring distances can all be simulated in software.

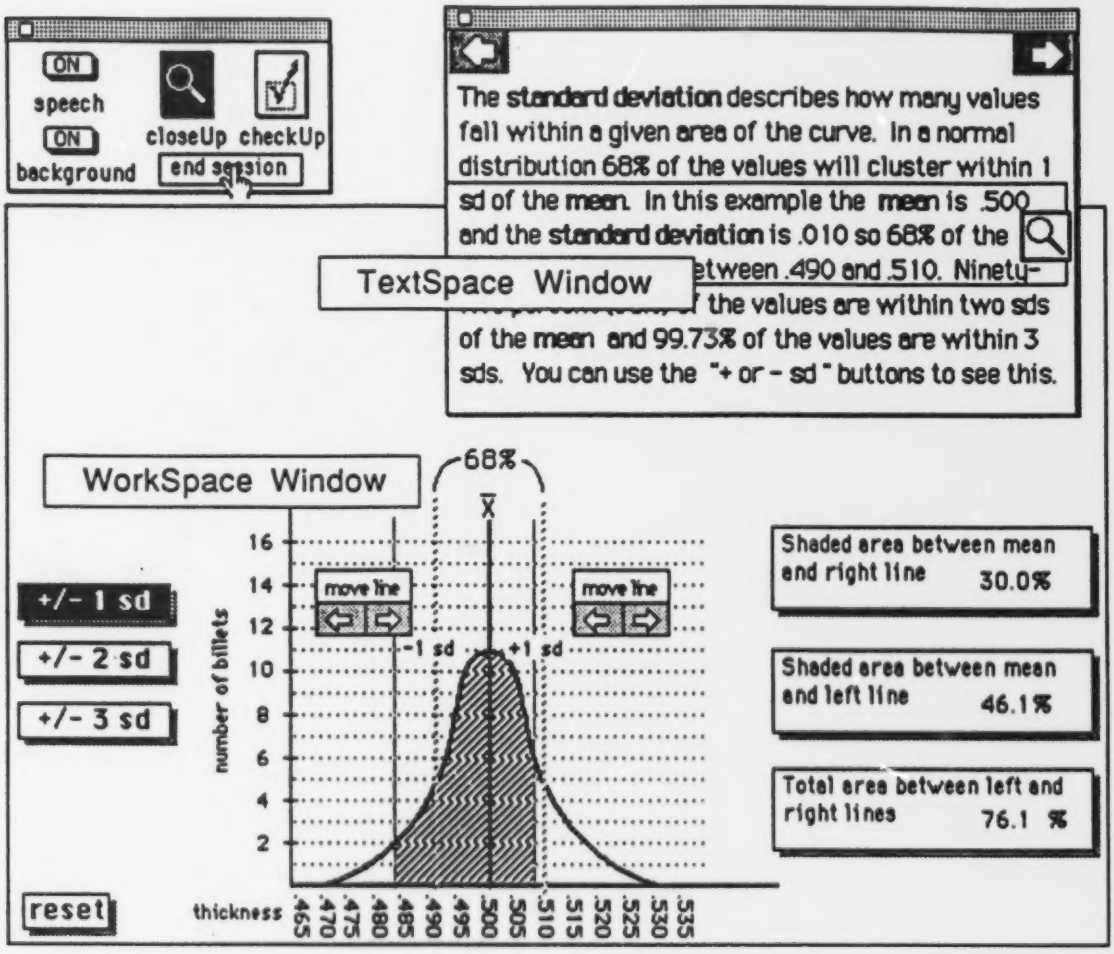

MAJOR STRUCTURAL COMPONENTS OF A JET ENGINE.
Jet engines are composed of several major structural components or sections: the 1) compressor, 2) combustor, 3) turbine, 4) exhaust, and the 5) accessory drive. The sections work together to collect and compress air, to inject fuel, and to expel rapidly moving exhaust gases from the rear of the engine (thus providing the thrust that propels the aircraft). The accessory drive section provides power to operate the engine and aircraft systems.
? ? ? ? ?
exhaust
accessory drive
compressor
combustor
turbine
✓checkup
Cover each ? with the right label (click and drag the labels.
89
?
ON
speech
ON
background
quit

Variations on the Basic Model

The initial version of Responsive Text was used effectively as part of the demonstration grant. Based on experience we learned that workplace education requires more than the ability to read text. The material frequentiy asks the reader to consult a chart, read a graph, or do a calculation and training that ignores these skills will not prepare the reader for the kinds of materials he/she is likely to use.

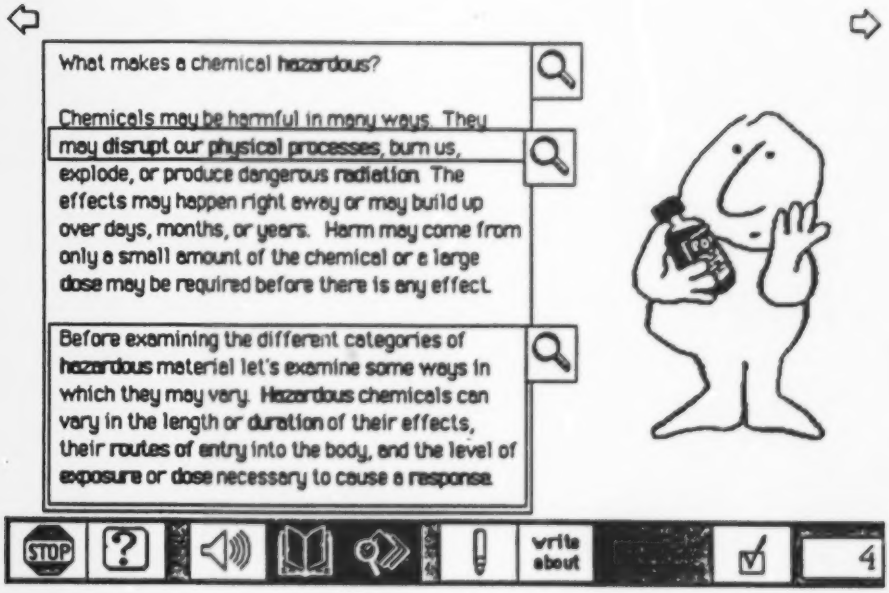
We also found that while using job-specific material has its benefits it also narrows the audience. Many of the texts were drawn from very specific training materials. Workers who didn't need to be trained in this particular job skill were less interested in learning basic skills using these materials--even though the basic skills were not specific to the job skills be taught.

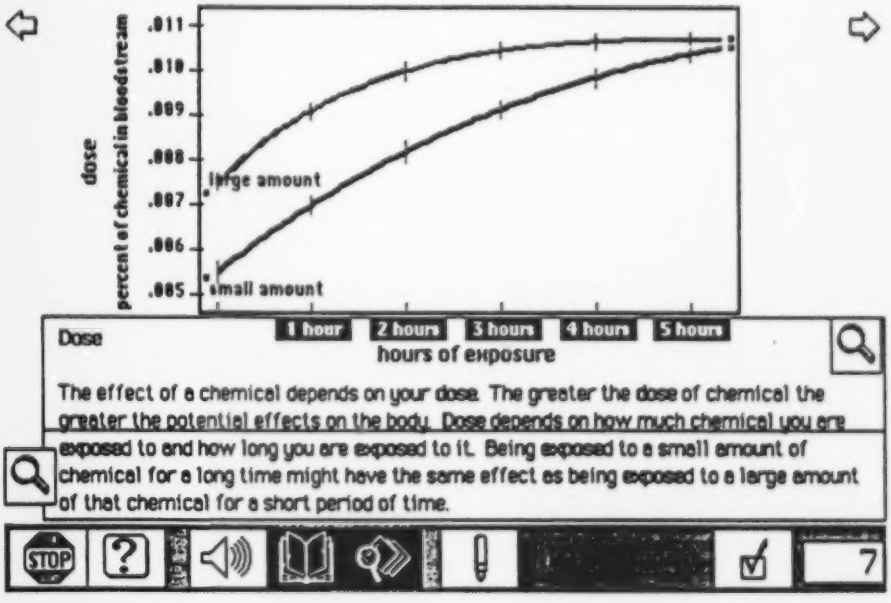
We used this knowledge in the design of subsequent versions of Responsive Text. One example, shown below, is a lesson on the basic skills needed for Statistical Process Control. In addition to the basic capabilities of the first Responsive Text instruction in basic math, understanding graphs, and problems solving was added to the instruction of basic principles of probability and statistics. Also in this implementation, a more powerful programming language enabled us to open multiple windows with information.



This multi-skill approach is also being applied in a new series of Responsive Text modules being developed under funding from a second workplace literacy demonstration grant.

Using our earlier experience we've once again selected job-relevant topics with the additional criterion that the topics are of interest in many different kinds of work sites. The sample screen shown below comes from a lesson on using hazardous materials. Because the Occupational Safety and Health Administration (OSHA) requires most companies that use hazardous materials to provide this type of training it should be of interest to a wide spectrum of site. In this project alone, the same material will be used in a manufacturing, health care, and construction setting.


What makes a chemical hazardous?
Chemicals may be harmful in many ways. They may disrupt our physical processes, burn us, explode, or produce dangerous radiation. The effects may happen right away or may build up over days, months, or years. Harm may come from only a small amount of the chemical or a large dose may be required before there is any effect.
Before examining the different categories of hazardous material let's examine some ways in which they may vary. Hazardous chemicals can vary in the length or duration of their effects, their routes of entry into the body, and the level of exposure or dose necessary to cause a response.
STOP
write about
4


dose
percent of chemical in bloodstream
.011
.010
.009
.008
.007
.006
.005
large amount
small amount
1 hour
2 hours
3 hours
4 hours
5 hours
hours of exposure
Dose
The effect of a chemical depends on your dose. The greater the dose of chemical the greater the potential effects on the body. Dose depends on how much chemical you are exposed to and how long you are exposed to it. Being exposed to a small amount of chemical for a long time might have the same effect as being exposed to a large amount of that chemical for a short period of time.
STOP
7

These materials will emphasize a multiple skill approach to literacy. The checkup questions not only cover reading skills but interpreting charts and graphs, basic math, and problem solving. There is also an increased emphasis on writing using an online notebook with writing suggestions.

Developing Your Own Material

While the materials shown here have required extensive programming and development, the basic tools for developing materials like this are available to anyone with a Macintosh or Windows-based computer. Depending on your level of expertise, you can make a text of your choosing more responsive. What is required is a investment in computer hardware, software, and time.

Hardware

A Macintosh system to do simple materials will requires a basic computer (SE, LCII, etc.) with hard disk and at least 1 megabyte of internal memory. Most of the new computers from Apple have 4 Megabytes of memory, 40 megabyte hard disks, and a color monitor.

MS-DOS systems must be capable of running Windows™. Best bet is a 486-based system with a VGA or Super VGA Monitor. These systems are made by many different manufacturers and continue to drop in price.

Other useful hardware includes

Scanner ($800 and up) -Allows you to digitize pictures so they may be displayed on the computer. Black and white and color scanners (more expensive) are available.

Sound system($200 to $500). For encoding sound and (for MS-DOS) systems) playing it back. Some of the later Macintoshes have this capability built in most of the others and all MS-DOS machines need additional hardware for using sounds.

Video Capture board ($245 to $2,000+) For capturing video sequences for display. Both Macintosh and Windows based computers can now display video images on the computer screen without special equipment.

Software

While there are many different programs available, I will only report on those with which I have had direct experience. All of the Responsive Text material was developed using object-orientations authoring language. Authoring languages are easier to use than more traditional programming languages and provide the capability to rapidly prototype and change a program. Object-oriented means that the programs are developed as small self-contained programs that are relatively independent of each other. In many object-oriented languages the objects are already programmed in the form of buttons (that you can activate with a mouse click) text fields (that hold text and hypertext), and pictures (that can be programmed to move around the screen). Novice users can construct programs by combining these pre-programmed objects together--software tinker toys. More advanced users can develop their own objects by writing custom "scripts" for new or existing objects.

The first and most widely available example of this kind of software is *HyperCard*™. Initially HyperCard was packaged as part of every Macintosh and it gained widespread acceptance. Now every Macintosh is shipped with a HyperCard "player" that can be used to display a HyperCard program. To develop the program, however, requires the purchase of a developer's system from Apple (under $200).

A HyperCard-like program called *SuperCard* shares all of Hypercard's features but also adds color and multiple window capacity. SuperCard tends to work better on more powerful Macintoshes. Unfortunately, as of this writing the future of SuperCard is uncertain and it is no longer supported by its manufacturer.

At the high end of the cost scale is a product called *Authorware* from Macromedia. This program has become popular in industrial training but it carrys a hefty ($4-5,000) price tag. One advantage of Authorware is that material developed in Authorware can be made to run on both Macintosh and Windows compatible computers.

Until recently, MS-DOS systems had nothing comparable to HyperCard. With the emergence of the Windows interface MS-DOS systems began to look more like Macintosh computers. It wasn't too long before Asymetrix Co, developed a true HyperCard-like program for Windows called *Toolbook*.

Expertise

It is beyond the scope of this paper to provide an extensive tutorial.on programming and design. Fortunately, most authoring software comes with tutorial instruction on how to set up a basic screen so even a beginner can create simple buttons to show additional text or speak a word, sentence, or entire passage.

To go beyond the first level you will need to learn more about the scripting

language that is part of your development system. While these language differ between systems--HyperCard's script is called *Hypertalk*, SuperCard's is called *SuperTalk*, and ToolBook's is called *OpenScript*. -- They share many of the same programming features.

The issue of design also becomes very important. As practitioners of Adult Education you need to ensure that the programs you build have the same instructional integrity that you expect of other curriculum material. If you develop an instructional program test it out with one person while you watch them use it. You'll quickly discover areas that need to be changed or improved. Fortunately, the authoring languages allow you to quickly change things without having to redo the entire program.

The greatest benefit of these authoring systems is that it makes it easier for those familiar with the field to develop materials sensitive to the needs of the adult learner. Effective instructional material is not produced by those who know how but by those who know why.

For more information about our work in Responsive Text contact:

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LexIcon Systems
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Sharon VT, 05065
(802) 763-7599

References

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